

## SHORT COMMUNICATION

**New and Further Chromosome Number Determinations in Japanese *Arisaema* (Araceae)**KUNIAKI WATANABE<sup>1</sup>, TOMIKI KOBAYASHI<sup>2</sup> and JIN MURATA<sup>3</sup>

<sup>1</sup>Department of Biology, Graduate School of Science, Kobe University, Rokkodai 1-1, Kobe, 657-8501, Japan; <sup>2</sup>The Society for Flora of Hyogo, 583-36 Oookuradanishimizu, Akashi, 673-0865, Japan; <sup>3</sup>Botanical Gardens, Graduate School of Science, University of Tokyo, Hakusan 3-7-1, Bunkyo-Ku, Tokyo 112-0001, Japan

Chromosome numbers are reported for 23 strains from 19 populations attributed to 12 species of Japanese *Arisaema*. The chromosome numbers of *A. galeiforme* ( $2n = 28$ ) and *A. kuratae* ( $2n = 28$ ) are reported for the first time. The remaining counts support previously reported determinations (most of which were single counts) and thus add to the knowledge of chromosome number distribution within the species of *Arisaema*. Some taxonomic problems are briefly discussed.

Key words: Araceae, *Arisaema*, *Arisaema galeiforme*, *Arisaema kuratae*, *Arisaema nagiense*, *Arisaema kawashimae*, chromosome number

The genus *Arisaema* (Araceae) comprises about 170 species (Murata 1995), among which about 70 species have been examined cytologically by many authors (Petersen 1989, Watanabe *et al.* 1998, Murata *et al.* 2006). The range of distribution of several species are rather restricted to local areas and few species exhibit a wide distributional range. There remain, therefore, the possibility of finding additional new species through more intensive field surveys and through the examination of specimens. In Japanese *Arisaema*, Murata (1995) recognized eight morphological groups and showed their distributional patterns. Among them, we have studied intensively the *A. undulatifolium* group for more than twenty years (Serizawa 1980, Murata 1986, 1990, Kobayashi 1989, 1990, Kobayashi *et al.* 2000, 2003), which provided an opportunity to discover the chromo-

some number of  $2n = 26$  in *A. minus* (Seriz.) J. Murata (Watanabe *et al.* 1998). Still, many enigmas remain, even in the *A. undulatifolium* group. Besides continuing our studies of the *A. undulatifolium* group, we have therefore extended our study of chromosome numbers to several other groups.

Sample populations and voucher specimens are listed in Table 1. Voucher specimens are deposited in the herbaria of Shoei Junior College (SHO) and the University of Tokyo (TI). Excised root tips about 1 cm long were pretreated in ice water at 0°C for 24 hr and fixed in 3:1 ethanol-acetic acid solution for 1 hr at 4°C. They were then macerated with 1N HCl for 10 min at 60°C, stained with the Shiff's solution and squashed.

All chromosome numbers determined for the 23 strains from 19 populations attributed to 12

TABLE 1. Species, Collection localities, Number of plants examined, Voucher specimens and Chromosome numbers in *Arisaema*

Species (Japanese name) and Localities (Voucher specimen number)	No. plants	2n
<b>sect. <i>Pistillata</i> Nakai</b>		
<b>A. <i>amurense</i> group</b>		
<i>A. nagiense</i> T. Kobayashi & al. (Nagihiroha-tennansho)		
Chikusa-cho, Shiso-city, Hyogo Pref. ( <i>Kobayashi</i> 42817, 42818)	2	26
Nagi-cho, Katuta-gun, Okayama Pref. ( <i>Kobayashi</i> 42812, 42813)	2	26
<i>A. ovale</i> Nakai (Hiroha-tennansho)		
Chikusa-cho, Shiso-city, Hyogo Pref. ( <i>Kobayashi</i> 42313)	1	52
Nagi-cho, Katuta-gun, Okayama Pref. ( <i>Kobayashi</i> 40723)	1	52
Ooe-cho, Fukuchiyama-city, Kyoto Pref. ( <i>Kobayashi</i> 43001)	1	52
<b>A. <i>monophyllum</i> group</b>		
<i>A. iyoanum</i> Makino (Omogo-tennansho)		
Kumakoogen-cho, Kamiukena-gun, Ehime Pref. ( <i>Kobayashi</i> 43004)	1	28
<b>A. <i>nikoense</i> group</b>		
<i>A. kuratae</i> Seriz. (Amagi-tennansho)		
Higashiiizu-cho, Kamo-gun, Shizuoka Pref. ( <i>Kobayashi</i> 43003)	1	28
<i>A. nikoense</i> Nakai (Yumoto-mamushigusa)		
Yugashima-cho, Izu-city, Shizuoka Pref. ( <i>Kobayashi</i> 43002)	1	28
<b>A. <i>serratum</i> group</b>		
<i>A. galeiforme</i> Seriz. (Yamazato-mamushigusa)		
Ooshika-mura, Shimoina-gun, Nagano Pref. ( <i>Kobayashi</i> 43924)	1	28
<i>A. takedae</i> Makino (Oo-mamushigusa)		
Sugou, Yumesaki-cho, Himeji-city, Hyogo Pref. ( <i>Kobayashi</i> 43005)	1	28
<b>A. <i>undulatifolium</i> group</b>		
<i>A. aequinoctiale</i> Nakai & F. Maek. (Higan-mamushigusa)		
Itsukaichi-cho, Saeki-ku, Hiroshima-city, Hiroshima Pref. ( <i>Kobayashi</i> 42973)	1	26
Asa-cho, Asakita-ku, Hiroshima-city, Hiroshima Pref. ( <i>Kobayashi</i> 42975)	1	26
Akioota-cho, Yamagata-gun, Hiroshima Pref. ( <i>Kobayashi</i> 42977)	1	26
<i>A. kawashimae</i> Seriz. (Tokunoshima-tennansho)		
Tokunoshima-cho, Ooshima-gun, Kagoshima Pref. ( <i>Kobayashi</i> 42833)	2	28
<i>A. nambae</i> Kitam. (Takahashi-tennansho)		
Fujio, Fukuyama-city, Hiroshima Pref. ( <i>Kobayashi</i> 42958)	1	28
Kisa-cho, Miyoshi-city, Hiroshima Pref. ( <i>Kobayashi</i> 42982)	1	28
Mukaihara-cho, Akitakada-city, Hiroshima Pref. ( <i>Kobayashi</i> 43006)	1	28
<b>unassigned to any groups</b>		
<i>A. seppikoense</i> Kitam. (Seppiko-tennansho)		
Kamikawa-cho, Kanzaki-gun, Hyogo Pref. ( <i>Kobayashi</i> 39259, 39263)	2	26
<b>sect. <i>Flagellarisema</i> Nakai</b>		
<i>A. thunbergii</i> Blume (Nangoku-urashimasou)		
Sayou-cho, Sayou-gun, Hyogo Pref. ( <i>Kobayashi</i> 34377)	1	28

species are presented in Table 1. The first reports are given for *A. galeiforme* Seriz. ( $2n = 28$ , Fig.1) and *A. kuratae* Seriz. ( $2n = 28$ , Fig. 2).

Within the *A. amurense* group, *A. ovale* Nakai and *A. nagiense* T. Kobayashi, K. Sasamura & J. Murata were examined to clarify the relationship between them. Three strains of *A. ovale* collected from three prefectures have  $2n = 52$  (tetraploid based on  $x = 13$ ). In contrast, *A. nagiense* has  $2n = 26$  and is diploid based on  $x = 13$  (Kobayashi *et al.* 2008). Although one of three collection localities of *A. ovale* overlaps the distribution range of *A. nagiense*, no hybrids between them have been found. It is necessary, however, to conduct further cyto-geographical studies, because chromosome numbers  $2n = 39$  (Serizawa 1981a) and  $2n = 65$  (Murata 1990a), as well as  $2n = 26$  and  $2n = 52$  (see Watanabe *et al.* 1998), have been reported at various localities.

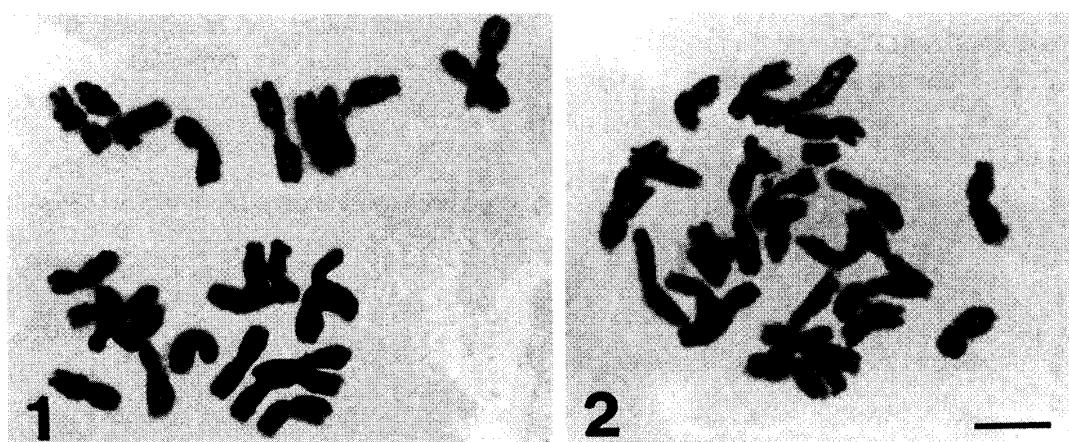
Within the *A. monophyllum* group, *A. iyonum* Makino has  $2n = 28$  chromosomes.

Although Serizawa (1981) regarded *A. kuratae* Seriz. to be a member of the *A. nikoense* group, Kobayashi (unpublished) found it differed in the morphology of the first leaf from other members of the *A. nikoense* group. The chromosome number of  $2n = 28$ , however, is the same as in other members of the *A. nikoense* group.

Within the *A. serratum* group, *A. galeiforme* Seriz. and *A. takedae* Makino were examined to clarify the relationship between them. Both species have a chromosome number of  $2n = 28$ .

Within the *A. undulatifolium* group, *A. aequinoctiale* Nakai & F. Maek. and *A. nambae* Kitam. in the Chugoku district were examined to clarify their distributional boundaries. *Arisaema aequinoctiale* has  $2n = 26$  and occurs from the west side of Hiroshima City, Hiroshima Pref., to Yamaguchi Pref. In comparison, *A. nambae* has  $2n = 28$  and is distributed from the west side of Akitakada City, Hiroshima Pref. to Okayama Pref. Populations of the two species are separated from each other by about 40 km. Although their distributional boundaries are rather close, no hybrids between them have been found in this area.

Another member of the *A. undulatifolium* group is the critically endangered and endemic species *A. kawashimae* Seriz. which grows on mountain tops on Tokunoshima. *Arisaema kawashimae* had not been seen since Serizawa (1980) described its characteristics and reported its chromosome number ( $2n = 28$ ). Recently, in the same area, Kobayashi observed a newly found population comprising about ten individuals. Two individuals have a chromosome number of  $2n = 28$ . As Serizawa (1980) noted, the spathe does not



FIGS. 1–2. Somatic metaphase chromosomes in *Arisaema*. 1. *A. galeiforme* ( $2n = 28$ ). 2. *A. kuratae* Seriz. ( $2n = 28$ ). Scale bar = 5  $\mu$ m.

open before extension of the leaves, which is not in agreement with other members of the *A. undulatifolium* group. Whether this species should be classified in the *A. undulatifolium* group requires further study.

One species unassigned to any group, *Arisaema seppikoense* Kitam. (Murata 1995), has  $2n = 26$ , which agrees with a previous report (Watanabe *et al.* 1998). *Arisaema thunbergii* Blume (sect. *Flagellarisema*) has  $2n = 28$ , which also supports an earlier report (Petersen 1989).

We would like to thank Dr. H. Ikeda of University Museum, University of Tokyo, Mr. H. Yamashita of Kagoshima Pref., Mr. S. Matsumoto of Hyogo Pref. and Mr. J. Seno of Kyoto Pref. for providing valuable information about *Arisaema* localities and plant materials.

## References

Kobayashi, T. 1989. The plants of western Kobe. Akashi. (in Japanese)

Kobayashi, T. 1990. Notes on the new localities and the taxonomic characters of *Arisaema minus* (Seriz.). J. Murata. J. Phytogeogr. & Taxon. 38: 23–25. (in Japanese)

Kobayashi, T., J. Murata & K. Watanabe 2000. The distribution of five taxa of the *Arisaema undulatifolium* group (Araceae) in western Japan. Acta Phytotax. Geobot. 51: 57–66.

Kobayashi, T., J. Murata, T. Suzuki & K. Watanabe. 2003. Taxonomic revision of the *A. undulatifolium* group (Araceae). Acta Phytotax. Geobot. 51: 1–17.

Kobayashi, T., K. Sasamura, K. Watanabe & J. Murata 2008. *Arisaema inaense* and *A. nagiense*, Two diploid species of the *A. ovale* group (Araceae). Acta Phytotax. Geobot. 59: 37–43.

Murata, J. 1986. Comments on taxonomic characters and the taxonomy of Japanese *Arisaema* (Araceae). (2) Length of the peduncle and number of ovules with special reference to *A. undulatifolium* and *A. kishidai*. Acta Phytotax. Geobot. 46: 185–208. (in Japanese)

Murata, J. 1990. Introduction to the plants of *Arisaema* recently recognized from Japan. Aroideana 13: 225–232.

Murata, J. 1990a. New or noteworthy chromosome records in *Arisaema* (Araceae) (2). J. Jap. Bot. 65: 225–232.

Murata, J. 1995. Diversity in the *Arisaema serratum* group. Acta Phytotax. Geobot. 46: 185–208. (in Japanese)

Murata, J., H. Murata, T. Sugawara, Y. Yang & S.-G. Wu 2006. New or noteworthy chromosome records in *Arisaema* (Araceae) (3). J. Jap. Bot. 81: 20–25.

Petersen, G. 1989. Cytology and systematics of Araceae. Nord. J. Bot. 9: 119–166.

Serizawa, S. 1980. Studies on the genus *Arisaema* in Japan (1). Group of *Arisaema undulatifolium*. J. Jap. Bot. 55: 148–156. (in Japanese)

Serizawa, S. 1981. Studies on the genus *Arisaema* in Japan (3). Group of *Arisaema nikoense*. J. Jap. Bot. 56: 90–96. (in Japanese)

Serizawa, S. 1981a. Studies on the genus *Arisaema* in Japan (4). Group of *Arisaema amurense* group and *A. longipedunculatum* group. Acta Phytotax. Geobot. 32: 22–30. (in Japanese)

Watanabe, K., T. Kobayashi & J. Murata 1998. Cytology and systematics in Japanese *Arisaema* (Araceae). J. Pl. Res. 111: 509–521.

Received February 13, 2008; accepted May 3, 2008